

# Guiding ecological principles for marine spatial planning

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## Introduction

The health of global marine ecosystems is in serious decline, and multiple stressors, including overfishing, pollution, invasive species, coastal development, and climate change, compromise the ability of ocean and coastal ecosystems to support and sustain the goods and services people want and need. Maintaining the well-being of ocean ecosystems, as well as their ability to provide essential ecosystem services for human populations, will require an alternative strategy to replace the current patchwork of complex, uncoordinated, and often disjointed rules and regulations governing use of coastal and ocean waters around the world. The future of the oceans depends on successful, timely implementation of a comprehensive governance framework that moves away from a sector-by-sector management approach to one that 1) balances the increasing number, diversity, and intensity of human activities with the ocean's ability to provide ecosystem services; 2) incorporates appropriate ecological, economic, social, and cultural perspectives; and 3) supports management that is coordinated at the scale of ecosystems as well as political jurisdictions.

Figure 1 (right). The complexity of human use in the coastal waters of Southern California. From Crowder et al. Science (2006) 313: 617-618. Courtesy of Monica Pessino



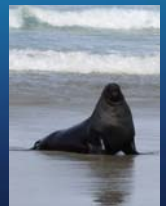
## What is Ecosystem-based Marine Spatial Planning?

- Proactive, integrated, and comprehensive decision making process to determine how activities can best be organized to sustain use and maintain ecosystem health
- Combines ecological, economic, and social objectives
- Identifies areas that are appropriate for specific types of activities in order to reduce conflicts between users and the environment
- Adaptive process that adjusts with new data and changing conditions
- Participatory process that actively involves stakeholders



## Ecological Principles and Modifying Guidelines for MSP

In order for Ecosystem-based marine spatial planning (EB-MSP) to be a successful mechanism for maintaining ecosystem health, specific and measurable scientific guidelines must inform the goals and objectives of the process and be used to develop spatial plans. In an effort to develop these guidelines, COS convened a workshop of ~20 government, NGO, and academic ecologists to produce a synthetic list of ecological principles for EB-MSP. Below are the four ecological principles and two modifying guidelines that emerged from the workshop.



Principle	Important features	Ecosystem function(s) supported
<b>Maintain species diversity</b>	<ul style="list-style-type: none"><li>- Species diversity &amp; composition</li><li>- Genetic Diversity</li><li>- Functional redundancy</li></ul>	<ul style="list-style-type: none"><li>- Productivity</li><li>- Resilience (resistance &amp; recovery)</li><li>- Food web stability</li></ul>
<b>Maintain habitat diversity &amp; heterogeneity</b>	<ul style="list-style-type: none"><li>- Habitat representation</li><li>- Habitat arrangement</li><li>- Dynamic habitats</li></ul>	<ul style="list-style-type: none"><li>- Species diversity</li><li>- Connectivity</li><li>- Shelter/refuge</li><li>- Productivity</li></ul>
<b>Maintain populations of key species</b>	<ul style="list-style-type: none"><li>- Keystone species</li><li>- Foundation species/groups</li><li>- Basal prey</li><li>- Top predators</li></ul>	<ul style="list-style-type: none"><li>- Species diversity</li><li>- Food web stability</li><li>- Resilience</li><li>- Ecosystem engineering</li></ul>
<b>Maintain connectivity</b>	<ul style="list-style-type: none"><li>- Population and species persistence</li><li>- Flow of subsidies</li></ul>	<ul style="list-style-type: none"><li>- Species diversity</li><li>- Metapopulation &amp; metacommunity dynamics</li></ul>
Guideline	Important features	
<b>Context</b>	<ul style="list-style-type: none"><li>- Regional considerations</li><li>- Spatial &amp; temporal scales</li></ul>	
<b>Uncertainty</b>	<ul style="list-style-type: none"><li>- Complex interactions</li><li>- Non-linear dynamics</li></ul>	

## Key steps in a MSP process

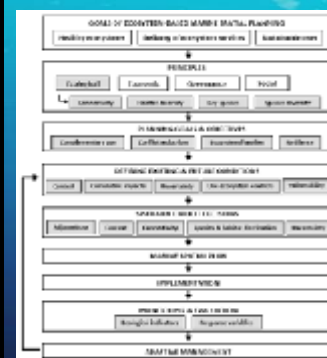


Figure 2. Key steps of any marine spatial planning process with an emphasis on how ecological principles (boxes shaded in gray) can be used throughout the planning and implementation process. These ecological principles would be used in conjunction with economic, governance, and social principles to develop and implement a comprehensive marine spatial plan.

References: Foley, MM et al. Marine Policy (2010); Ehler, C. and F. Douvère. UNESCO (2009); Crowder, L et al. Science (2006).

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